4.4-2 A W21 × 101(**W530 × 150**) is used as compression member with one end fixed and the other end free. The length is 10 feet(**3,000 mm**) . What is the nominal compressive strength if $F_y = 50$ ksi (**345 MPa**) ? *Note that this is a slender-element compression member, and the equations of AISC Section E7 must be used.*

$K = 2.1$ FROM TABLE C-A-7.1 (16.1-650)

W21×101 (c)

$A_g = 29.8\,in^2$ $r_x = 9.02\,in$ $r_y = 2.89\,in$

$t_w = 0.50\,in$ $b_f = 12.3\,in$ $t_f = 0.80\,in$

$k_{DES} = 1.3\,in$ $d = 21.4\,in$ $k_{DES} = 1.3\,in$

$$\lambda_r = \frac{L_c}{r} = \frac{2.1(10\,ft)(12\,in/ft)}{2.89\,in} = 87.20$$

$$4.71\sqrt{E/F_y} = 4.71\sqrt{\frac{29{,}000\,ksi}{50\,ksi}} = 113.43$$

$$\frac{L_c}{r} < 4.71\sqrt{E/F_y} \Longrightarrow \text{USE EQ. E3-2}$$

$$F_e = \frac{\pi^2 E}{(\lambda_c)^2} = \frac{\pi^2(29{,}000\,ksi)}{(87.20)^2} = 37.64\,ksi$$

$$F_n = F_y\left(0.658^{F_y/F_e}\right) = 50\,ksi\left(0.658^{50/37.64}\right) = 28.68$$

$$P_n = F_n A_g = 28.68\,ksi(29.8\,in^2) = \underline{854.52\,k}$$

CHECK WIDTH-THICKNESS RATIOS TABLE B4.1a (16.1-21) 2/2

$$b_f/2t_f = \frac{12.3\,in}{2(0.80\,in)} = 7.69$$

$$\lambda_r = 0.56\sqrt{E/F_y}$$

$$= 0.56\sqrt{\frac{29{,}000\,ksi}{50\,ksi}} = 13.49$$

FLANGE NOT SLENDER

$b/t < \lambda_r$

$$\frac{h}{t_w} = \frac{d - 2k_{des}}{t_w}$$

$$= \frac{21.4\,in - 2(1.30\,in)}{0.50\,in}$$

$$= 37.60 > \lambda_r$$

$$\lambda_r = 1.49\sqrt{E/F_y}$$

$$= 1.49\sqrt{\frac{29{,}000\,ksi}{50\,ksi}} = 35.88$$

WEB IS SLENDER*

$$\lambda_r\sqrt{\frac{F_y}{F_n}} = 35.88\sqrt{\frac{50\,ksi}{28.68\,ksi}} = 47.37$$

$\lambda = 37.6 < \lambda_r\sqrt{\frac{F_y}{F_n}} \Rightarrow b_e = b$ *

- NO REDUCTION IN A_g